

HIGH ENERGY REPLACEMENT FOR TEFLON PROPELLANT IN PULSED PLASMA THRUSTERS, Phase I

Completed Technology Project (2004 - 2004)



Project Introduction

This program will utilize a well-characterized Pulsed Plasma Thruster (PPT) to test experimental high-energy extinguishable solid propellants (HE), instead of standard Teflon propellant. ET Materials LLC originally formulated this material as an environmentally friendly automotive airbag inflator propellant. In preliminary testing, the material was found suitable for use in PPTs. Electric arc discharges of the PPT apparently causes only thin surface layers of the energetic propellant to be ignited, without uncontrolled propagation to underlying propellant. The current Isp of these propellants is ~225 sec. but newer formulations appear to be reaching an Isp of 245 sec., essentially that of ammonium perchlorate propellants. The relative thrust contribution from plasma ionization and thermal expansion of non-ionized combustion gases will determine how much the energetic fuel enhances PPT performance. All testing and evaluation of the HE propellant will be conducted using the Aerojet Modular Test Unit Pulsed Plasma Thruster. This modular test unit was specifically designed to evaluate new flight configurations of the EO-1 PPT design. Using the high-energy propellant in the EO-1 PPT, should increase dramatically increase. This program will provide NASA with directly applicable results for a high-energy drop-in alternative propellant for the EO-1 PPT, providing new mission capabilities.

Anticipated Benefits

Miniaturized PPT's for onboard propulsion are one of the few viable options for small satellites in the 10 kg and lower total mass region. Such satellites are of military interests in programs being developed by the Air Force, DARPA and MDA. In addition there is a growing commercial interest in small satellites that are being developed and built by University and Private companies. The high energetic propellants being developed in this program also could be used commercially for gas generation systems, such as automobile air bags, turbine starters or valve actuators. The use of energetic Pulsed Plasma Thrusters demonstrated in this program has specific application for primary propulsion of small spacecraft for orbit raising and life extension of low earth missions. Several studies have shown that an all PPT attitude control system has a significant mass benefit over wheel, torque rods and thrusters used for attitude control. Such NASA missions as the Space Technology 5, 6 and 7 and THEMIS that require both attitude and translational positioning could benefit from this technology. Successful demonstration in these missions would provide enabling technology for later Origins missions, such as the Terrestrial Planet Finder



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission
Directorate (STMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

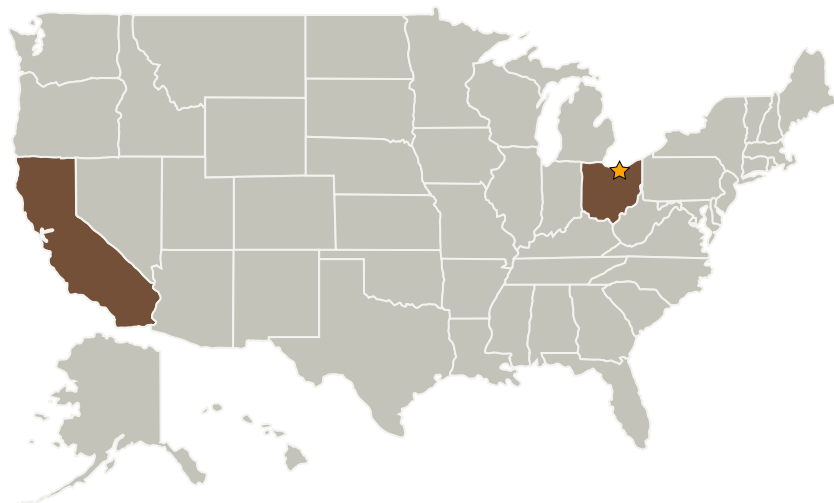
Small Business Innovation
Research/Small Business Tech
Transfer

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
ET Materials, LLC	Supporting Organization	Industry	Rancho Cordova, California

Primary U.S. Work Locations

California	Ohio
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Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Manager:

Eric J Pencil

Principal Investigator:

Charles Grix

Technology Areas

Primary:

- TX01 Propulsion Systems
 - └ TX01.1 Chemical Space Propulsion
 - └ TX01.1.1 Integrated Systems and Ancillary Technologies